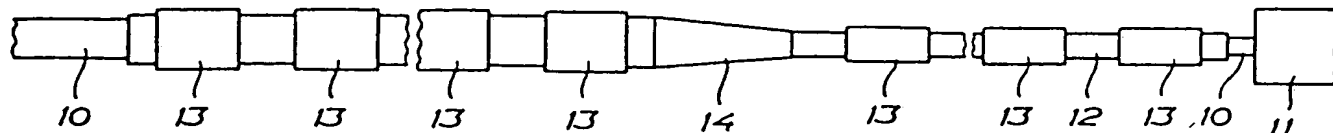


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>3</sup> :</b> <b>B29D 23/00, 7/24, 23/04</b> <b>B29G 2/00; B29C 25/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 84/01920</b> <b>(43) International Publication Date:</b> <b>24 May 1984 (24.05.84)</b>
<b>(21) International Application Number:</b> PCT/SE83/00398 <b>(22) International Filing Date:</b> 15 November 1983 (15.11.83) <b>(31) Priority Application Number:</b> 8206483-3 <b>(32) Priority Date:</b> 15 November 1982 (15.11.82) <b>(33) Priority Country:</b> SE  <b>(71) Applicant (for all designated States except US):</b> UPON-OR AB [SE/SE]; Postbox 1, S-513 00 Fristad (SE). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only) :</b> ÅGREN, Lennart [SE/SE]; Lyckogången 6, S-502 49 Borås (SE).  <b>(74) Agents:</b> STRÖM, Tore et al.; Ström & Gulliksson AB, Rundelsgatan 14, S-211 36 Malmö (SE).		<b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CH (European patent), DE, DE (European patent), FR (European patent), GB (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>

**(54) Title:** METHOD FOR ORIENTATION OF THE MATERIAL OF PLASTIC TUBES



**(57) Abstract**

Method for orientation of the material of tubes (10) of plastic wherein the plastic tube is passed through a heated jacket tube (12). The plastic tube is held under an internal positive pressure inside the jacket tube is to be exposed to tempering in an initial stage and then to be exposed to orientation in a following wider portion of the jacket tube by the plastic tube being expanded against the tube wall under the action of the internal positive pressure in said latter portion of the jacket tube.

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# METHOD FOR ORIENTATION OF THE MATERIAL OF PLASTIC TUBES

This invention relates to a method for orientation of the material of plastic tubes, e.g. tubes of poly-olefins such as polyethylene or cross-linked poly-ethylene, PVC and ABS.

It is known that plastic material can be made stronger by effecting orientation of the material. The advantage of the orientation is that the tube will be stronger and can stand a higher burst pressure, but the method of orientation of the tube to the extent it is applied on the whole, is an expensive and troublesome process.

A method for cross-linking tubes of polyethylene in the manufacture of so-called PEX tubes comprises the step of passing the tube through a salt bath when the tube has left the extruder, said bath being held at a high uniform temperature. In order to avoid collapsing of the tube in the salt bath and in order to effect a precalibration to an approximate intended diameter of the tube, the tube is held under a low internal pressure when passing through the salt bath which may have a length of about 15 m. When PEX tubes having larger dimensions (40 mm diameter or more) are to be manufactured the problem is encountered that the tube will be oval in the salt bath due to the fact that the tube by buoyancy in the salt bath will be pressed against the overlying rollers provided to maintain the tube in the salt bath.

The object of the invention is particularly to provide in direct connection with the cross-linking of polyethylene tubes, an orientation of the plastic material while the difficulties mentioned above in connection with the use of a salt bath at the same time are eliminated, and, moreover, to provide this by a

method which can easily be included in the production line without causing increased production time. However, the invention as to the broad aspects thereof can be applied to the orientation of the material of plastic tubes which are not cross-linked or which have  
5 been cross-linked in another way.

For this purpose there is provided a method for orientation of the material of plastic tubes with the characteristics appearing from claim 1.

10 In order to explain the invention in more detail reference is made to the accompanying drawing which discloses diagrammatically an equipment for working the method of the invention for cross-linking and orientation of polyethylene.

15 A polyethylene tube 10 is extruded from an extruder 11 and from the extruder is passed into a jacket tube 12 of steel which is kept at a uniform temperature of 130 to 300°C, preferably at about 250°C, e.g. by heating by means of external heaters 13. The  
20 polyethylene the temperature of which may be higher than the temperature maintained in the tube 12, when the polyethylene tube leaves the extruder, will be tempered in the tube 12. If the polyethylene has not said higher temperature, the polyethylene will be heated in the steel  
25 tube. Inside the steel tube 12 the polyethylene tube is held under an internal positive pressure of 0.1 - 25 bar by means of a fluid supplied, preferably an inert gas, e.g. nitrogen. In order that the polyethylene tube will  
30 slide unobstructedly through the steel tube a lubricant, preferably with high or relatively high viscosity (> 400 cSt at 20°C) can be supplied between the surfaces sliding against each other.

In an initial stage, the plastic tube will be cross-linked and after the distance required for the cross-linking, the steel tube changes at a conical portion  
35

14 into a wider portion wherein the cross-linked tube will be expanded under the action of the internal positive pressure to engage the inner side of the wider portion of the steel tube such that the plastic material will be exposed to orientation.

Thus, it will be seen that the polyethylene tube immediately after the extrusion will be exposed to continuous cross-linking and orientation while being calibrated at the same time when moving through the steel tube 12 substantially at the velocity at which the tube is being extruded. The final product is an orientated PEX tube which has improved strength properties and is calibrated and moreover presents a regular cylindrical form.

The polyethylene tube supplied to the initial portion of the steel tube 12 can be cross-linked already, e.g. by radiation. The only purpose of the heating and expansion in the steel tube in that case is to effect the desired orientation of the cross-linked polyethylene material of the tube.

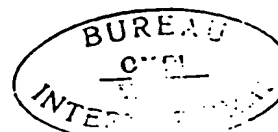
# CLAIMS

1. Method for orientation of the material of plastic tubes wherein the plastic tube (10) is passed through a heated jacket tube (12) in which the plastic tube in an initial stage is tempered in a tempering zone, and wherein the plastic tube then in a succeeding stage is exposed to orientation by the plastic tube being expanded under the action of an internal positive pressure, c h a r a c t e r i z e d in that the plastic tube (10) comprises a tube of polyethylene which is cross-linked before or during the tempering.

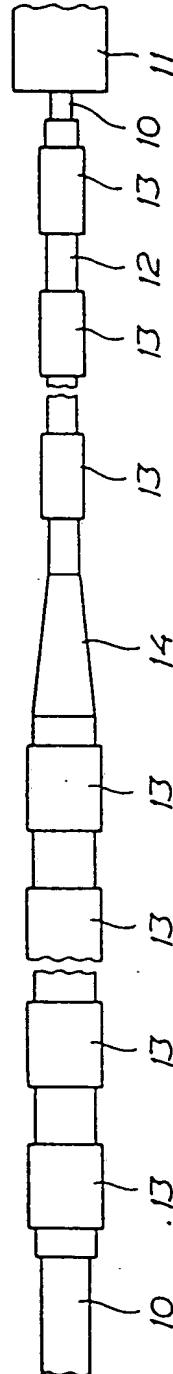
2. Method as claimed in claim 1, c h a r a c - t e r i z e d in that the expansion is effected in a flaring portion of the jacket tube (12) downstream of the tempering zone.

3. Method as claimed in claim 1 or 2, c h a r a c - t e r i z e d in that the jacket tube (12) is held at a temperature between 130 and 300°C, preferably at about 250°C.

4. Method as claimed in any of claims 1 to 3, c h a r a c t e r i z e d in that a lubricant is applied between the plastic tube (10) and the jacket tube (12).



1/1



SUBSTITUTE SHEET



Corrected

## INTERNATIONAL SEARCH REPORT

International Application No PCT/SE83/00398

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC 3

B 29 D 23/00, 7/24, 23/04 B 29 G 2/00 B 29 C 25/00

## II. FIELDS SEARCHED

## Minimum Documentation Searched \*

## Classification System

## Classification Symbols

IPC 3 B 29 C 25/00 B 29 D 7/02, 7/20, 7/24, 23/00, 23/04  
 B 29 F 3/08 B 29 G 2/00  
 US C1 264: 88, 90, 92-95, 98-100, 210, 210.1, .../...

Documentation Searched other than Minimum Documentation  
 to the extent that such documents are included in the fields searched \*

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>14</sup>

Category *	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>
X	US, A, 3 296 344 (R TIMMERMAN) 29 May 1963	1
A	US, A, 2 936 491 (C B HAMLIN) 19 December 1956	1-4
A	US, A, 3 201 503 (C J BENNING ET AL) 31 January 1962	1-4
A	US, A, 2 716 777 (N HAGEN) 14 August 1951	1-4
A	DE, C, 675 525 (SIEMENS= SCHUCKERTWERKE AKT-GES) 21 April 1939 & US 2047554	1-4
A	DE, A1, 2 051 390 (VERLINGTE DEUTSCHE METALL WERKE AG) 20 October 1970	1-4
A	DE, A1, 2 200 964 (KABEL UND METALLWERKE GUTEHOFFNUNGSHÜFFE AG) 10 January 1972	1-4
	.../...	

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Δ" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search <sup>1</sup>

1984-01-31

Date of Mailing of this International Search Report <sup>2</sup>

1984-02-14

International Searching Authority <sup>3</sup>

Swedish Patent Office

Signature of Authorized Officer <sup>16</sup>
  
 Stefan E Lindén



## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II

Fields Searched (cont)

US C1

210.2, 210.5, 210.7, 231,  
 234-236, 288, 288.4, 289.3,  
 289.6, 290, 290.2, 291, 345-  
 347, 500, 502, 555, 563-568,  
 571, 572, 425: 66, 72, 110-  
 113, 115, 376, 378-381, 383,  
 384, 387, 387.1, 392, 393,  
 404, 522, 526

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>13</sup>

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter <sup>13</sup> not required to be searched by this Authority, namely:

2. ☐ Claim numbers ..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out <sup>13</sup>, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>11</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

## Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

## III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, <sup>1a</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No <sup>1a</sup>
A	DE, A1, 2 719 308 (SIEMENS AG) 2 November 1978	1-4